

Docket No. 1021.43050X00
Serial No. 10/643,975
Office Action dated September 15, 2006

AMENDMENTS TO THE DRAWINGS

A Replacement Drawing Sheet containing Figs. 4A and 4B is attached.

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REMARKS

I. Introduction

By the present Amendment, claims 1, 2, 7, and 9 have been amended. No claims have been added or canceled. Accordingly, claims 1-10 remain pending in the application. Claims 1, 2, and 7 are independent.

II. Office Action Summary

In the Office Action of September 15, 2006, the Drawings were objected to. The Title of the invention was objected to. Claims 2, 6, 9, and 10 were rejected under 35 USC §112, second paragraph, as being indefinite. Claims 1-6 were rejected under 35 USC §101 as being directed to non-statutory subject matter. Claims 1, 3, 7, and 8 were rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 5,796,693 issued to Taguchi et al. ("Taguchi"). These rejections are respectfully traversed.

III. Allowable Subject Matter

The Examiner's indication that claims 9 and 10 would be allowable, if rewritten in independent form to include all the limitations of the base claim and any intervening claims, is noted with appreciation.

IV. Objections to the Drawings and Title

The Drawings were objected to because Fig. 4A contained a typographical error. Concurrently submitted herewith is a Replacement Sheet (containing drawing Figs. 4A and 4B) that corrects the typographical error.

Withdrawal of this objection is therefore respectfully requested. The Title of the Invention was objected to as being non-descriptive. The Examiner further

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required submission of a new title that is clearly indicative of the invention to which the claims are directed.

By the present Amendment, Applicants have amended the Title of the Invention to recite "INFORMATION REPRODUCING METHOD AND AN INFORMATION REPRODUCING DRIVE UTILIZING PRML TO OUTPUT BINARY VALUES."

This title is believed to be indicative of the invention to which the claims are directed.

V. Rejections under 35 USC §112

Claims 2, 6, 9, and 10 were rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter regarded as the invention. Regarding this rejection, the Office Action cites several instances of language that was considered indefinite and/or otherwise lacking in proper antecedent basis.

By the present Amendment, Applicants have made various changes to claims 2 and 9, in part, to address the issues of indefiniteness raised in the Office Action. These amendments also remedy the rejections of claims 6 and 10, based on their dependence from these claims.

Applicants therefore respectfully submit that, as amended, the presently pending claims satisfy the requirements of 35 USC §112, second paragraph.

VI. Rejections under 35 USC §101

Claims 1-6 were rejected under 35 USC §101 as being directed to non-statutory subject matter. Regarding this rejection, the Office Action indicates that the cited claims are directed to methods of transforming a reproduced signal into a

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binary value, and therefore are non-statutory. The Office Action further states that a process consisting solely of mathematical operations such as converting a set of numbers into another set of numbers, does not manipulate appropriate subject matter to define a statutory process.

By the present Amendment, Applicants have amended claims 1 and 2 to describe physical acts resulting, in part, from the data manipulation. Specifically, the manipulated data is output to an information reproduction device where reproduction physically takes place. As such, the claims are believed to be statutory subject matter.

VII. Rejections under 35 USC §102

Claims 1, 3, 7, and 8 were rejected under 35 USC §102(b) as being anticipated by Taguchi. Regarding this rejection, the Office Action alleges that Taguchi discloses an information reproducing method that employs a PRML method to compare a target signal with each reproduced signal for a continuous N time to select the most likelihood one of state changes therein, thereby transforming said reproduced signal to a binary value. The Office Action further indicates that when the PRML method is represented as PR ($\alpha_1, \alpha_2, \dots, \alpha_n$), the left most m1 and m2 satisfy a relationship set forth in independent claim 1. Applicants respectfully disagree.

As amended, independent claim 1 defines an information reproducing method that employs a PRML method to compare a target signal with each reproduced signal for a continuous N time to select the most likelihood of one of state changes therein. The method of independent claim 1 provides that:

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wherein, when said PRML method is represented as $PR(\alpha_1, \alpha_2, \dots, \alpha_N)$, the leftmost M_1 coefficient and the rightmost M_2 coefficient in a coefficient array are all zero while integer values M_1 and M_2 satisfy a relationship of " $M_1 \geq 0, M_2 \geq 0, M_1 + M_2 \geq 1, M_1 + M_2 < N$ "; and

wherein, when integer $MM = M_1 + M_2$ and integer $NN = N - MM$ are satisfied, said method includes:

a step of using a target value obtained by adding 2^N or less compensated values V_2 , stored in a pattern compensation table, corresponding to a value of an N -bit digital bit array to an initial target level V_1 obtained by a convolution operation of each of NN non-zero coefficient values and an NN -bit digital bit array, said pattern compensation table being located in a decode unit;

a step of binarizing said reproduced signal to the most likelihood bit array while comparing said reproduced signal with said target value ($V_1 + V_2$); and

outputting the results of the step of binarizing and the step of setting to an information reproducing device.

According to independent claim 1, the PRML method is represented as $PR(\alpha_1, \alpha_2, \dots, \alpha_N)$. The leftmost M_1 coefficient and the rightmost M_2 coefficient in a coefficient array are all zero while integer values M_1 and M_2 satisfy a relationship of $M_1 \geq 0, M_2 \geq 0, M_1 + M_2 \geq 1, M_1 + M_2 < N$. When an integer $MM = M_1 + M_2$ and an integer $NN = N - MM$ are satisfied, a target value is obtained by adding 2^N or less compensated values V_2 that are stored in a pattern compensation table. The compensated values correspond to a value of an N -bit digital bit array to an initial target level V_1 obtained by a convolution operation of each of NN non-zero coefficient values and an NN -bit digital bit array. According to independent claim 1, the pattern compensation table is located in a decode unit. Next, the reproduced signal is binarized to the most likelihood bit array while comparing said reproduced signal with said target value ($V_1 + V_2$). The results are subsequently output to an information reproducing device.

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According to independent claim 1, the pattern compensation table is located inside the decode unit and stores compensated target levels for all patterns (i.e., combinations of bit arrays). An initial target value and a compensation value are added according to the bit array. However, a branch metric calculation unit simultaneously calculates target values for all the bit arrays. See Fig. 12 and corresponding description. By calculating all the target values, it is possible to compare the reproduced waveform level and compensated target levels at the same time, thereby improving the maximum likelihood detection.

Taguchi discloses a data reproduction apparatus and method for an optical disk which has a maximum likelihood detection. The system compensates stationary edge shift and edge shift depending on a record pattern at the time of reproduction. According to Taguchi, predetermined data is recorded in the VFO area, SYNC area, etc., prior to the data area of the optical disk being detected by the maximum likelihood detection. The edge shift amount is calculated based on the detection data, and the expected value compensation table closest to the calculated edge shift amount is selected to be optimum. See column 5, lines 1-11. Accordingly, the edge shifts of various data patterns are calculated only at the VFO and SYNC areas, which are not the data area.

Typically, the VFO and SYNC areas occupy less than 5% of the data segment. This provides insufficient sampling data, resulting in compensation values that can contain large errors. In a high capacity optical disk, the signal amplitude of the minimum run-length (2T) signal is zero, because the lengths of the 2T marks and 2T spaces are shorter than the optical resolution limit of the pickup head. Accordingly, it is difficult to measure or calculate the edge shifts of the 2T marks or spaces, because the signal amplitude is zero and the inter-symbol interference is

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high. Consequently, Taguchi only calculates the edge shifts at the VFO and SYNC areas. Furthermore, the system of Taguchi is inapplicable to optical disks that do not contain VFO and SYNC areas (e.g., CD, DVD-ROM, BD-ROM, etc). Taguchi simply fails to simultaneously calculate target values for the bit array using a compensation table stored in a decode unit, including:

a step of using a target value obtained by adding 2^N or less compensated values V2, stored in a pattern compensation table, corresponding to a value of an N-bit digital bit array to an initial target level V1 obtained by a convolution operation of each of NN non-zero coefficient values and an NN-bit digital bit array, said pattern compensation table being located in a decode unit;

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claim 3 depends from independent claim 1, and is therefore believed to be allowable for at least the reasons set forth above with respect to independent claim 1. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

Independent claim 7 defines an information reproducing drive that outputs a library value obtained from a reproduced signal using a PRML method. The drive comprises:

a PR target output unit for outputting a PR class target value corresponding to an N-bit bit array;
a decode unit including a pattern compensation table for storing a compensation value corresponding to each M-bit ($M > N$) bit array;
a waveform equalizer for equalizing a reproduced signal; and
a branch metric calculation unit for calculating a branch metric value for each bit array by employing a target value obtained by adding up a PR target value output from said PR target value output unit and a compensation value stored in said pattern compensation table with respect to an output from said waveform equalizer.

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The information reproducing apparatus of independent claim 7 includes hardware capable of performing various functions that are similar to steps recited in independent claim 1. For example, information reproducing drive of independent claim 7 includes a decode unit that stores a pattern compensation table. Additionally, a branch metric calculation unit is used to calculate a branch metric value using a target value obtained by adding a PR target value output from the PR target value output unit and a compensation value stored in said pattern compensation table. As previously discussed, Taguchi does not provide a compensation table that is stored in the decode unit, and does not calculate a branch metric value for each bit array, as set forth in the present invention.

It is therefore respectfully submitted that independent claim 7 is allowable over the art of record.

Claim 8 depends from independent claim 7, and is therefore believed to be allowable for at least the reasons set forth above with respect to independent claim 7. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

VIII. Conclusion

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, the issuance of a Notice of Allowance is believed in order, and courteously solicited.


If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

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AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 1021.43050X00).

Respectfully submitted,
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Attachment: Replacement Drawing Sheet